DESCRIPTION

IMAGE SUPPLY DEVICE, RECORDING APPARATUS,

RECORDING SYSTEM, AND CONTROL METHOD THEREFOR

5   TECHNICAL FIELD

The present invention relates to an image supply device such as a digital camera, a recording apparatus, a recording system, and a control method therefor.

10   BACKGROUND ART

In recent years, digital cameras (image sensing devices) which can sense images and convert them into digital image data by simple operations have been prevalent. When an image sensed by such camera is
15   printed and used as a photo, it is a common practice to temporarily download the sensed digital image data from a digital camera to a PC (computer), execute an image process by the PC, and output the processed image data from the PC to a color printer, thus printing an image.

20   By contrast, for example, a color print system which allows a digital camera to directly transfer digital image data to a color printer without the intervention of any PC and can print it out, a so-called photo-direct (PD) printer in which a memory
25   card that is mounted in a digital camera and stores sensed images can be directly mounted in the color printer and sensed images stored in the memory card can

be printed have recently been developed.

Particularly, in order to directly transfer image
data from a digital camera to a printer and print the
image data, demands have arisen for standardization of
5   interface specifications between a digital camera of
each manufacturer and a printer, the operation method,
and the like. One proposal for standardization is a
guideline for realizing a DPS (Direct Print System).

However, a printer which directly receives image
10   data from a digital camera and prints the image can
also receive print data from a PC or the like in
addition to the digital camera and print the data. For
this reason, a response to a command from the digital
camera may delay due to issuing of a print request from
15   the PC when a pre-procedure for receiving image data
between the printer and the digital camera is executed.
For example, when a print start request is issued by
the digital camera and received by the printer, a
status representing that the next command can be
20   accepted changes from "true" to "false", and the camera
is notified of this status. If, however, e.g., a print
request is simultaneously issued from a PC, the printer
cannot quickly notify the camera of the status change.
During this period, the camera may determine that the
25   next command can also be accepted by the printer, and
issue the command to the printer in spite of the
printer being in busy state.

DISCLOSURE OF INVENTION

The present invention has been made in consideration of the above situation, and has a feature to provide an image supply device which, when a response coping with a procedure determined in advance between the image supply device and a recording apparatus is not received from the recording apparatus, determines that the status of the recording apparatus is a status estimated from a normal procedure, and decides subsequent process procedures, a recording apparatus, a recording system, and a control method therefor.

According to the present invention, there is provided with an image supply device used in a recording system in which the image supply device and a recording apparatus are directly connected via a communication interface, and image data is transmitted from the image supply device to the recording apparatus and recorded, characterized by comprising: reception means for receiving status information from the recording apparatus; determination means for determining whether said reception means has received predetermined status information from the recording apparatus within a predetermined time period after the image supply device issues a predetermined command to the recording apparatus; and process means for, in a

case where the determination means determines that no predetermined status information has been received, determining a status as a status to be estimated from a normal process, and continuing a process.

5　　　According to the present invention, there is provided with a recording apparatus used in a recording system in which an image supply device and the recording apparatus communicate with each other via a communication interface, and image data is transmitted

10　from the image supply device to the recording apparatus and recorded, characterized by comprising: command issuing means for issuing a predetermined command to the image supply device; reception means for receiving a signal from the image supply device after the command

15　issuing means issues the predetermined command; determination means for determining whether the signal received by the reception means is a response corresponding to the predetermined command; and control means for controlling an issuing timing of a next

20　command to the image supply device in a case where the determination means determines that the signal is not the response corresponding to the predetermined command.

　　Other features and advantages of the present invention will be apparent from the following

25　descriptions taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures

thereof.

BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings, which are incorporated

5   in and constitute a part of the specification,

illustrate embodiments of the invention and, together

with the descriptions, serve to explain the principle

of the invention.

Fig. 1 depicts a schematic perspective view of a

10 PD printer according to an embodiment of the present

invention;

Fig. 2 depicts a schematic view of the control

panel of the PD printer according to the embodiment;

Fig. 3 is a block diagram showing the arrangement

15 of principal part associated with control of the PD

printer according to the embodiment;

Fig. 4 is a block diagram showing the arrangement

of a DSC according to the embodiment;

Fig. 5 depicts a view for explaining connection

20 between the PD printer and a digital camera according

to the embodiment;

Fig. 6 depicts a chart for explaining command

exchange between the PD printer and the DSC in a print

system according to the embodiment;

25 Fig. 7 depicts a view for explaining an example

of a print start command issued by the DSC according to

the embodiment;

Figs. 8A and 8B depict views for explaining
JobStatus and DeviceStatus according to the embodiment;

Fig. 9 is a flow chart showing a print restart
process by a DSC according to the first embodiment;

5   Fig. 10 is a flow chart for explaining a process
by a DSC according to the third embodiment;

Fig. 11 is a flow chart for explaining a process
accompanying button operation for continuing printing
in a DSC according to the fourth embodiment;

10   Fig. 12 is a flow chart for explaining a process
accompanying button operation for aborting printing in
the DSC according to the fourth embodiment;

Fig. 13 is a flow chart for explaining a process
by a DSC according to the fifth embodiment;

15   Fig. 14 is a flow chart for explaining a process
by a PD printer according to the sixth embodiment; and

Fig. 15 is a flow chart for explaining another
process by the PD printer according to the sixth
embodiment.

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BEST MODE FOR CARRYING OUT THE INVENTION

Preferred embodiments of the present invention
will now be described in detail below with reference to
the accompanying drawings.

25   Fig. 1 depicts a schematic perspective view of a
photo direct printer (to be referred to as a PD printer
hereinafter) 1000 according to an embodiment of the

present invention. The PD printer 1000 has a function

of receiving data from a host computer (PC) and

printing the data as a general PC printer, and a

function of directly reading and printing image data

5   stored in a storage medium such as a memory card, or

receiving image data from a digital camera and printing

the data.

Referring to Fig. 1, a main body which forms the

housing of the PD printer 1000 according to the

10   embodiment has a lower case 1001, upper case 1002,

access cover 1003, and exhaust tray 1004 as exterior

members. The lower case 1001 nearly forms the lower

half portion of the PD printer 1000, and the upper case

1002 nearly forms the upper half portion of the main

15   body. These cases are combined to form a hollow

structure having a storage space which stores

mechanisms (to be described later). Openings are

respectively formed in the upper and front surfaces of

the main body. One end of the exhaust tray 1004 is

20   rotatably held by the lower case 1001, and rotation of

the tray 1004 opens/closes the opening formed in the

front surface of the lower case 1001. In executing

print operation, the exhaust tray 1004 is rotated

toward the front surface side to open the opening.

25   Print sheets can be exhausted from the opening, and

sequentially stacked on the exhaust tray 1004. The

exhaust tray 1004 stores two auxiliary trays 1004a and

1004b. If necessary, the auxiliary trays can be pulled

out to enlarge/reduce the loading area of print sheets

in three steps.

One end of the access cover 1003 is rotatably

5   held by the upper case 1002 so as to be able to

open/close the opening formed in the upper surface. By

opening the access cover 1003, a printhead cartridge

(not shown), ink tank (not shown), or the like stored

in the main body can be exchanged. Although not shown,

10   when the access cover 1003 is opened/closed, a

projection formed on the rear surface of the cover 1003

rotates a cover open/close lever. The open/close state

of the access cover 1003 can be detected by detecting

the rotation position of the lever by a microswitch or

15   the like.

A power key 1005 is arranged on the upper surface

of the upper case 1002. A control panel 1010 which

comprises a liquid crystal display unit 1006, various

key switches, and the like is provided on the right

20   side of the upper case 1002. The structure of the

control panel 1010 will be described in detail later

with reference to Fig. 2. Reference numeral 1007

denotes an automatic feeder which automatically feeds a

print sheet into the apparatus main body. Reference

25   numeral 1008 denotes a paper gap select lever which is

used to adjust the gap between the printhead and a

print sheet. Reference numeral 1009 denotes a card

slot which receives an adapter capable of receiving a
memory card. Image data stored in the memory card can
be directly read and printed via this adapter.
Examples of the memory card (PC) are a compact flash™

5   memory card, smart media card, and memory stick.
Reference numeral 1011 denotes a viewer (liquid crystal
display unit) which is detachable from the main body of
the PD printer 1000, and is used to display an image
for one frame, index image, or the like when the user

10   wants to search images stored in the PC card for an
image to be printed. Reference numeral 1012 denotes a
USB terminal which is used to connect a digital camera
(to be described later). Also, another USB connector
for connecting a personal computer (PC) is provided on

15   the rear surface of the PD printer 1000.

Fig. 2 depicts a schematic view of the control
panel 1010 of the PD printer 1000 according to the
embodiment.

Referring to Fig. 2, the liquid crystal display

20   unit 1006 displays menu items for various setups of
data associated with items printed on the right and
left sides of the unit 1006. The items displayed in
the liquid crystal display unit 1006 include, e.g., the
first number or designated frame number of a photo to

25   be printed (start/designate), the final photo number
subjected to printing end operation (end), the number
of copies to be printed (copy count), the type of paper

sheet (print sheet) used for printing (paper type), the
setup of the number of photos to be printed on one
paper sheet (layout), designation of print quality
(quality), designation as to whether or not to print a
5   photographing date (date print), designation as to
whether or not to print a photo after correction (image
correction), display of the number of paper sheets
required for printing (paper count), and the like.
These items are selected or designated using cursor
10   keys 2001 by a user. Reference numeral 2002 denotes a
mode key. Every time the mode key 2002 is pressed, the
type of print (index print, all-frame print, one-frame
print, and the like) can be switched, and a
corresponding one of LEDs 2003 is turned on in
15   accordance with the selected type of print. Reference
numeral 2004 denotes a maintenance key which is used to
perform maintenance of the printer such as cleaning of
the printhead. Reference numeral 2005 denotes a print
start key which is pressed when the start of print is
20   designated or when the maintenance setup is settled.
Reference numeral 2006 denotes a print cancel key which
is pressed when printing or maintenance is canceled.

     The arrangement of principal part associated with
control of the PD printer 1000 according to the
25   embodiment will be described below with reference to
Fig. 3. In Fig. 3, the same reference numerals denote
parts common to those in the above drawings, and a

description thereof will be omitted.

Referring to Fig. 3, reference numeral 3000 denotes a controller (control board). Reference numeral 3001 denotes an ASIC (dedicated custom LSI).

5   Reference numeral 3002 denotes a DSP (Digital Signal Processor) which incorporates a CPU and executes various control processes (to be described later), and image processes such as conversion from a luminance signal (RGB) into a density signal (CMYK), scaling,

10   gamma conversion, and error diffusion. Reference numeral 3003 denotes a memory having a program memory 3003a which stores a control program for the CPU of the DSP 3002, a RAM area has a memory area functioning as a work area which stores image data and the like.

15   Reference numeral 3004 denotes a printer engine. In the embodiment, the printer is equipped with a printer engine for an ink-jet printer which prints a color image by using a plurality of color inks. Reference numeral 3005 denotes a USB connector serving as a port

20   for connecting a digital camera (DSC) 3012. Reference numeral 3006 denotes a connector for connecting the viewer 1011. Reference numeral 3008 denotes a USB hub (USB HUB). When the PD printer 1000 executes printing on the basis of image data from a PC 3010, the USB hub

25   3008 allows data from the PC 3010 to pass through it, and outputs the data to the printer engine 3004 via a USB 3021. The connected PC 3010 can directly exchange

data and signals with the printer engine 3004 and

execute printing (functions as a general PC printer).

Reference numeral 3009 denotes a power supply connector

which inputs a DC voltage converted from commercial AC

5   power from a power supply 3019. The PC 3010 is a

general personal computer. Reference numeral 3011

denotes a memory card (PC card) mentioned above; and

numeral 3012 denotes the digital camera (to be also

referred to as a DSC: Digital Still Camera).

10   Note that signals are exchanged between the

controller 3000 and the printer engine 3004 via the USB

3021 or an IEEE1284 bus 3022.

       Fig. 4 is a block diagram showing the arrangement

of the DSC (Digital Still Camera) 3012.

15   Referring to Fig. 4, reference numeral 3100

denotes a CPU which controls the overall DSC 3012; and

numeral 3101 denotes a ROM which stores the process

sequence (control program) of the CPU 3100. Reference

numeral 3102 denotes a RAM which is used as a work area

20   for the CPU 3100; and numeral 3103 denotes a switch

group which is used to perform various operations. The

switch group 3103 includes various switches, cursor

keys, and the like. Reference numeral 2700 denotes a

liquid crystal display unit which is used to display an

25   image photographed at present or a sensed/stored image

and display a menu for performing various setups to the

DSC 3012. Reference numeral 3105 denotes an optical

unit which mainly comprises a lens and its drive system.
Reference numeral 3106 denotes a CCD element; and
numeral 3107 denotes a driver which drives and controls
the optical unit 3105 under the control of the CPU 3100.

5   Reference numeral 3108 denotes a connector for
connecting a storage medium 3109 (compact flash™ memory
card, smart media card, or the like); and numeral 3110
denotes a USB interface (USB slave side) for connecting
a PC or the PD printer 1000 of the embodiment.

10   Fig. 5 depicts a view for explaining connection
between the PD printer 1000 and the DSC 3012 according
to the embodiment. The same reference numerals denote
parts common to those in the above drawings, and a
description thereof will be omitted.

15   Referring to Fig. 5, a cable 5000 comprises a
connector 5001 which is connected to the connector 1012
of the PD printer 1000, and a connector 5002 for
connecting a connector 5003 of the digital camera 3012.
The digital camera 3012 can output image data saved in

20   an internal memory (memory card) via the connector
5003. The digital camera 3012 can take various
arrangements such as an arrangement which incorporates
a memory as a storage means and an arrangement having a
slot for inserting a removal memory. The PD printer

25   1000 and digital camera 3012 are connected via the
cable 5000 shown in Fig. 5, and image data from the

digital camera 3012 can be directly sent to the PD

printer 100 and printed by the PD printer 1000.

Operation examples of the print system according

to the embodiment on the basis of the above arrangement

5   will be explained as embodiments.

[First Embodiment]

The outline of the operation of a print system

including a DSC 3012 and PD printer 1000 based on the

above arrangement will be described. In the print

10 system according to the first embodiment, the DSC 3012

and PD printer 1000 can operate in accordance with DPS

(Direct Print System) specifications.

Fig. 6 depicts a chart for explaining a sequence

when the DSC 3012 issues a print request to the PD

15 printer 1000 to print in the print system according to

the first embodiment.

This process sequence is executed when the PD

printer 1000 and DSC 3012 are connected via a cable

5000 and have confirmed that they comply with the DPS

20 specifications. The DSC 3012 transmits

"ConfigurePrintService" to the PD printer 1000 to

acquire the state of the PD printer 1000 (600). In

response to this, the PD printer 1000 notifies the DSC

3012 of the current state (in this case, "idle" state)

25 of the PD printer 1000 (601). The DSC 3012 inquires

the capability of the PD printer 1000 (602), and issues

a print start request (StartJob) corresponding to the

capability (603). The print start request is issued on
condition that "newJobOK" (Fig. 8B) in status
information (to be described later) from the PD printer
1000 is "True" in 601.

5   In response to the print start request, the PD
printer 1000 requests file information of the DSC 3012
on the basis of the file ID of image data to be printed
(604). In response to this, the DSC 3012 transmits
file information. The file information contains items
10   of information such as the file capacity (file size),
presence/absence of a thumbnail image, and file
attributes. When the PD printer 1000 receives the file
information and determines that the file can be
processed, the PD printer 1000 requests the file of the
15   DSC 3012 (605). The DSC 3012 sends image data of the
requested file to the DSC 3012. After then, when the
PD printer 1000 starts a print process, the PD printer
1000 sends status information representing "Printing"
to the DSC 3012 by "NotifyDeviceStatus" in 606. After
20   a print process of one page ends, the PD printer 1000
notifies the DSC 3012 of the end of the print process
by "NotifyJobStatus" 607 at the start of processing the
next page. For print of only one page, the PD printer
1000 notifies the DSC 3012 of the "idle" state by
25   "NotifyDviceStatus" 608 at the end of printing one
requested page. For N-up print of laying out a
plurality of (N) images on one page and printing them,

the PD printer 1000 sends "NotifyJobStatus" 607 to the DSC 3012 every time N images are printed. The issuing timings of "NotifyJobStatus" and "NotifyDeviceStatus" and the image data acquisition order in the first

5 embodiment are merely examples, and various cases are conceivable depending on the product specification.

The print process includes a case in which the file IDs of image data to be printed are contained and transmitted at once in a print start request (StartJob)

10 from the DSC 3012 to perform print, and a case in which only the file ID of a DPOF file used in general photo development is contained in a print start request (StartJob) from the DSC 3012 and transmitted to the PD printer 1000, and the PD printer 1000 interprets the

15 DPOF file, acquires the file ID of necessary image data, and prints.

Fig. 7 depicts a view for explaining an example of a print start request issued by the DSC 3012 to the PD printer 1000.

20 In Fig. 7, numeral 720 denotes the configuration (jobConfig) of the print job, and numeral 721 denotes print information (printInfo).

The configuration 720 will be explained. Numeral 700 (quality) designates the print quality such as

25 "normal" or "high quality". Numeral 701 (paperSize) designates the paper size, and numeral 702 (paperType) designates the paper type such as "plain paper", "photo

paper", or "ink-jet paper". Numeral 703 (fileType) designates the type of an image file to be printed, and when, for example, DPOF is used, the type representing DPOF is designated by the file type 703. Numeral 704

5   (datePrint) designates whether or not to print a date, numeral 705 (fileNamePrint) designates whether or not to print a file name, numeral 706 (imageOptimize) designates whether or not to optimize an image, numeral 707 (fixedSize) designates whether or not to perform

10 fixed-size print, and numeral 708 (cropping) designates whether or not to print a designated range of an image.

The print information 721 contains a file ID 709 (fileId) and date information 710 (date).

Figs. 8A and 8B depict views for explaining items

15 of information contained in JobStatus and DeviceStatus described above. JobStatus (Fig. 8A) and DeviceStatus (Fig. 8B) are transmitted from the PD printer 1000 to the DSC 3012. The DSC 3012 can request the PD printer 1000 to transmit these items of information at an

20 arbitrary timing.

In Fig. 8A, "prtPID", "ImagePath", and "copyID" become effective when print of a DPOF file is designated. A "prtPID" is identification information (ID) of a print section designated by a DPOF file. An

25 "ImagePath" is information of a path for specifying an image file designated by the DPOF file. A "copyID" designates the number of a copy during print upon

designating print of a plurality of copies. In print
based on a DPOF file, the DSC 3012 describes "fileID"
of the DPOF file in a print start request (StartJob),
and transmits the print start request to the PD printer
5   1000. In response to this, the PD printer 1000 can
start printing the DPOF file. The PD printer 1000
acquires the DPOF file on the basis of "fileID" of the
DPOF file, executes "GetFileID", and specifies "fileID"
of an image file designated in the DPOF file. The PD
10   printer 1000 requests the image file of the DSC 3012,
and acquires the image data. As a result, an image
designated in the DPOF file can be printed. During
execution of print based on the DPOF file, the PD
printer 1000 notifies the DSC 3012 by "NotifyJobStatus"
15   of "prtPID", "ImagePath", and "copyID" representing the
progress of printing.

When the print process restarts after
interruption due to any reason during print of the DPOF
file, the print process restarts from a top of the page
20   at which the print process was aborted.

A "progress" represents the current page (N/T)
during print out of a prospective number of pages. N
represents the current print page, and T represents the
total number of print pages to be printed. An
25   "imagePrinted" represents the number of printed images.

A DeviceStatus (Fig. 8B) will be explained.

A "dpsPrintServiceStatus" designates the state of

the PD printer 1000, and is transmitted to the DSC 3012
from the PD printer 1000. A "dpsPrintServiceStatus"
includes idle, print, and pause states. A
"jobEndReason" designates the end state of a print
5   process, and is transmitted to the DSC 3012 upon the
completion of printing the final page. An
"errorStatus" represents an error state, and is
transmitted upon generation of an error. An
"errorReason" means a cause of generation the error,
10   and is transmitted together with "errorStatus".

A "disconnectEnable" means that print is possible
even if the USB cable 5000 is disconnected from the PD
printer 1000. The PD printer 1000 notifies the DSC
3012 of "disconnectEnable". A "capabilityChanged"
15   means that the capability in the PD printer 1000 has
been changed, and is transmitted to the DSC 3012. A
"newJobOK" means that the PD printer 1000 can accept a
print request, and is transmitted to the DSC 3012.

Fig. 9 is a flow chart showing a print restart
20   process in the DSC 3012 according to the first
embodiment. A program which executes this process is
stored in a ROM 3101, and a CPU 3100 executes a control
process in accordance with the program to realize the
process.

25   In this process, print operation is aborted when,
e.g., the cable 5000 is disconnected during execution
of a print job. After that, DPS reconnection is

established, the print button of the DSC 3012 is designated, and the PD printer 1000 is instructed to restart print operation. The PD printer 1000 then restarts print.

5   This process assumes that interruption of a print process in the PD printer 1000 and interruption of a print process in the DSC 3012 are recognized by the PD printer 1000 and the DSC 3012.

In step S1, it is determined whether the DSC 3012

10   and PD printer 1000 have physically been connected by connecting the cable 5000 or the like and DPS reconnection has been established. If the connection is established, the process advances to step S2. If the DSC 3012 designates the restart of print, it is

15   determined whether print process has been interrupted. If the print process has not interrupted, the process advances to step S3 to perform a normal print process such as a process of newly starting print process in accordance with a print instruction.

20   If the print process has been interrupted, the process advances to step S4. It is determined whether the PD printer 1000 which has newly established connection is of the same model (same <dpsVersion> and <productName>), the model of the same manufacturer

25   (<productName>), or the model of the same vendor (<vendorName>) as that of the PD printer 1000 which has interrupted the previous print process. In this

procedure, the model of the PD printer 1000 is
determined on the basis of contents sent as a response
from the PD printer 1000 for "ConfigurePrintService"
issued by the DSC 3012. When the same PD printer is
5   reconnected, no problem occurs. Even for a printer of
another model, if the manufacturer or vendor of the
printer is the same and a re-print process according to
the first embodiment is possible on the basis of the
design of the manufacturer or vendor, restart of
10 printing can be determined to be possible, and the
process advances to a subsequent process S6. If NO in
step S4, the process advances to step S5 to determine
that continuation of print process is impossible, and
display a message on the display unit 2700 of the DSC
15 3012. If necessary, the UI (user menu window)
displayed on the display unit 2700 may be changed.

If the reconnected apparatus is determined in
step S4 to be of a compatible model, the process
advances to step S6 to determine whether print process
20 is performed using a DPOF file. If YES in step S6, the
process advances to step S7 to transmit the file ID of
the DPOF file to the PD printer 1000. In this case,
"prtPID", "ImagePath", and "copyID" described above are
transmitted together with the file ID of the DPOF file,
25 thereby designating a file subjected to the restart of
print process using the DPOF file.

If the print process is not performed using DPOF

file in step S6, i.e., each image file is to be
designated and printed, the file IDs of image files
except printed image files among the file IDs of image
files to be printed are transmitted at once to the PD

5   printer 1000 to execute print. Note, as a print
restart instruction, a print button is designated among
the operation buttons of the DSC 3012 to send
"StartJob" from the DSC 3012 to the PD printer 1000 and
print process is restarted.

10   The PD printer 1000 notifies the DSC 3012 of the
end of printing each page by "jobStatus" (meaning the
start of printing the next page) sent from the PD
printer 1000 at the start of the next page, or
"jobEndReason" contained in "deviceStatus" for the

15   final page. The DSC 3012 can, therefore, confirm the
number of printed images. Whether print process has
been interrupted can be determined based on whether the
number of images designated by a print instruction have
been printed when images are printed one by one, or

20   from the progress ("prtPID", "ImagePath", and "copyID")
in a DPOF file or whether print process has been
completed when the print process is based on the DPOF
file.

            When one image is printed on one page, the number

25   of print paper sheets coincides with the number of
images. When, however, a plurality of (N) images are
laid out and printed on one paper sheet, the number of

images to be printed does not coincide with the number of print paper sheets. The DSC 3012 must make the number of print paper sheets and the number of image data match with each other in accordance with the print

5   mode.

[Second Embodiment]

When date print <datePrint> 704 in <jobConfig> 720 in Fig. 7 is designated, <date> 710 contained in <printInfo> 721 is printed. When date print

10 <datePrint> 704 in <jobConfig> 720 is not designated, date data is ignored and is not printed even if <date> 710 is contained in <printInfo> 721.

This can increase the degree of freedom of data contained in <printInfo> 721. A startJob command can

15 be created by, e.g., directly pasting, to <printInfo> 721, image data and a date list which are used by another job.

[Third Embodiment]

Fig. 10 is a flow chart for explaining a process

20 in a print system according to the third embodiment of the present invention.

In the third embodiment, when the DSC 3012 issues any command to the PD printer 1000 and the status of the PD printer 1000 changes, the PD printer 1000

25 notifies the DSC 3012 of the status by "NotifyDeviceStatus" described above. However, when the state of the PD printer 1000 does not change or a

response delays, the DSC 3012 determines (estimates)
that a prospective status change has occurred in the PD
printer 1000 by a previously issued command, and
executes a corresponding process. To confirm the state
5   of the PD printer 1000, the DSC 3012 issues
"GetDeviceStatus" to the PD printer 1000, acquires the
state of the PD printer 1000, and executes a process
corresponding to the acquired status of the printer.

An example of this process will be explained with
10   reference to the flow chart of Fig. 10.

In step S10, a print start request "StartJob" is
issued to the PD printer 1000. The process advances to
step S11 to determine whether a predetermined status
response "NotifyDeviceStatus" is received from the PD
15   printer 1000. If the PD printer 1000 is a product-type
capable of accepting only one print job, newJobOK of
NotifyDeviceStatus indicating that the PD printer 1000
can accept the next print job should represent "False"
after issuing the print start request "startJob" to the
20   PD printer 1000. If a normal response (newJobOK is
"False") is received in step S11, the process advances
to step S12 to wait until "newJobOK" changes to "True".
Thereafter, a normal print process of issuing the next
command or outputting image data or the like in
25   accordance with a request from the PD printer 1000 is
executed.

In step S13, it is determined whether

"NotExecuted" representing that "StartJob" could not be
executed has been received. If "NotExecuted" has been
received, the process advances to step S20 to issue
"GetDeviceStatus" to the PD printer 1000 and acquire

5   the current status of the PD printer 1000. If this
status reveals the reason why the instruction could not
be executed, and "StartJob" can be reissued, a message
to this effect is displayed on the UI of the display
unit 2700 of the DSC 3012. After then, if the user

10   designates reissuing of an instruction by using the
button 3103, the process advances from step S21 to S22
to reissue to the PD printer 1000 the "StartJob"
instruction which has not been executed. If no
reissuing designation is input in step S21, the process

15   advances from step S21 to step S19.

If no "NotExecuted" has been received in step S13,
the process advances to step S14 to determine whether
"NotSupported" has been received. If "NotSupported"
has been received, the process advances to step S15.

20   In this case, the previously issued "StartJob" is not
supported by the PD printer 1000, and, for example,
non-supported items (impossible designation) are
displayed on the UI of the display unit 2700 so as to
represent that the print instruction is not supported

25   by the PD printer 1000.

The meaning of not supporting the "StartJob"
instruction includes a case in which the PD printer

1000 does not support the "StartJob" instruction itself,
and also a case in which the PD printer 1000 supports
the "StartJob" instruction itself but does not support
the currently issued "StartJob" instruction because an
5   unsupported paper size or paper type is designated. In
this case, the UI of the DSC 3012 is so reconstructed
as to disable selection of an improper paper size or
paper type (items to be set for print operation),
similar to the above-described example. This can
10   decrease the possibility of receiving "NotSupported"
again when a "StartJob" instruction is executed again
to the PD printer 1000. Note, upon receiving the
"NotSupported", a process of, e.g., confirming a paper
size or paper type supported by the PD printer 1000 may
15   be performed.

      If no "NotSupported" has been received in step
S14, the process advances to step S11'. This step
assumes that the response content is substantially "OK".
If a predetermined status response is received in step
20   S11', the process advances to step S12 to continue a
normal operation. If no predetermined status
information is received in step S11', the process
advances to step S16 to determine whether to continue
the operation as normal operation. This may be
25   displayed using the above-mentioned UI to allow the
user to select the normal operation. If the process
shifts to the normal operation, the process advances to

step S12. If the user does not input any instruction
and the process does not shift to the normal operation,
the process advances to step S17 to request the status
of the PD printer 1000 by using "GetDeviceStatus". The
process advances to step S18, and the status of the PD
printer 1000 is acquired and if the status is an
ordinary one, this status is determined to be a
normally estimated one, and the process advances to
step S12. If another status is acquired, the process
advances to step S19 to execute a process corresponding
to the acquired status.

       The reason why unestimated "NotExecuted" has been
sent back as a response in step S13 is that, for
example, a PC 3010 is connected to the PD printer 1000,
a print instruction from the PC 3010 is received by the
PD printer 1000 at almost the same time as a print
start request from the DSC 3012 and a print process of
print data from the PC 3010 is commenced. That is,
since the DSC 3012 recognizes "newJobOK" = "True" in
advance on the basis of NotifyDeviceStatus issued by
the PD printer 1000, the DSC 3012 issues a "StartJob"
command. However, immediately when the "StartJob"
command is issued, "newJobOK" = "False" is set, and the
PD printer 1000 sends back "NotExecuted" as a response.
The DSC 3012 which has recognized "newJobOK" = "True"
receives the unestimated response "NotExecuted" from
the PD printer 1000. The reason why no predetermined

status information has been received in step S11 is

that, for example, the PD printer 1000 is a product

capable of accepting a plurality of print jobs and even

after a print request "StartJob" is accepted,

5   "newJobOK" of "DeviceStatus" is kept unchanged as

"True", and thus the PD printer 1000 does not issue

"NotifyDeviceStatus" to the DSC 3012. Also in this

case, the DSC 3012 securely operates on the assumption

that "newJobOK" is "False" until the state of the PD

10   printer 1000 has been confirmed by "GetDeviceStatus"

(because of the possibility of delaying issuing of

"NotifyDeviceStatus" representing "newJobOK" = "False"

due to any cause).

       The above description assumes that, even when a

15   command from the DSC 3012 and a command from the PD

printer 1000 are almost simultaneously issued, both the

commands become effective. However, there may be also

a direct print specification: "of almost simultaneously

issued commands, a command from the DSC 3012 is

20   preferentially processed, and issuing of a command from

the PD printer 1000 is ignored and discarded". In this

case, the check content in step S11 is "whether a

command issued from the PD printer 1000 has been

received?". If YES in step S11, the process advances

25   to step S13 via a step (not shown) of ignoring a

command from the PD printer 1000; if no command is

received from the printer 1000, the process directly

advances to step S13.

In the above direct print specification, the discarded command of the PD printer 1000 may be reissued by the PD printer 1000. A case in which a

5   print instruction from the PC 3010 is received at almost the same time as "StartJob" from the DSC 3012 and a print process for print data from the PC 3010 is commenced will be exemplified. The DSC 3012 which has recognized in advance "newJobOK" = "True" by

10   NotifyDeviceStatus issued by the PD printer 1000 in advance issues a "StartJob" instruction. At almost the same time, the PD printer 1000 which starts a print process for print data from the PC 3010 changes to "newJobOK" = "False". In order to notify the DSC 3012

15   of this, the PD printer 1000 issues a "NotifyDeviceStatus" instruction to the DSC 3012. However, the "NotifyDeviceStatus" instruction issued by the PD printer 1000 is discarded, and the "StartJob" instruction issued by the DSC 3012 is preferentially

20   processed. Since the PD printer 1000 has already changed "newJobOK" to "False", it sends back "NotExecuted" in response to the "StartJob" instruction. At this time, the PD printer 1000 must reissue the "NotifyDeviceStatus" instruction in order to notify the

25   DSC 3012 of "newJobOK" = "False". At this time, if the DSC 3012 issues the next command, instructions (commands) are almost simultaneously issued from the

two devices again.

Basically, the situation in which the two devices almost simultaneously issue commands and one of them is discarded may occur when criterion statuses used to

5   issue commands from the two devices are different. In this case, the direct print process becomes very unstable and is in a dangerous state. Hence, the situation in which the two devices almost simultaneously issue commands is preferably avoided as

10   much as possible. For this purpose, for example, when the DSC 3012 detects "issuing of a command from the PD printer 1000" in step S11, issuing of a "GetDeviceStatus" instruction may be inhibited in step S20 or S17 for a predetermined time period to wait for

15   a command from the PD printer 1000.

Also in the PD printer 1000 as a partner of the direct print, inhibition of issuing a command from the PD printer 1000 for a predetermined time period and a wait for a command from the DSC 3012 may be set. If,

20   however, these predetermined inhibition time periods are equal, commands will be almost simultaneously issued from the two devices after the elapse of the predetermined time period. Considering this possibility, the predetermined time period may not be

25   fixed and may be changed dynamically discontinuously or irregularly. Alternatively, the inhibition time period used when "issuing of a command by the PD printer 1000

is not detected" in step S11 may be used until "issuing
of a command by the PD printer 1000 is detected" in
step S11, and updated when "issuing of a command by the
PD printer 1000 is detected" in step S11. As a method

5   of changing the timing of issuing command, the issuing
timing may be advanced. To prevent the two devices
from changing to the same timing, the timing may be
changed by a predetermined rule. For example, the
timing change method may be set depending on the USB

10 host or slave. Alternatively, both the DSC 3012 and PD
printer 1000 may comprise means for generating random
timing signals, and command issuing timings may be
determined in accordance with the timing signals,
respectively. As described above, the PD printer 1000

15 may also be set to a state in which issuing of a
command from the PD printer 1000 is inhibited for a
predetermined time period, thereby decreasing the
possibility of almost simultaneously issuing commands
from the two devices. Various modifications described

20 above can also be applied.

[Fourth Embodiment]

A process of continuing print from the DSC 3012
in the print system according to the fourth embodiment
and a process of interrupting print process will be

25 described. Also in this case, the arrangement of the
print system and those of the DSC 3012 and a PD printer
1000 are the same as those described above, and a

description thereof will be omitted.

Fig. 11 is a flow chart for explaining a print continuation process executed when a print process in the DSC 3012 according to the fourth embodiment is

5   interrupted and then executed upon designating a print button which designates the print start.

In step S110, it is determined whether the print button among operation buttons 3103 of the DSC 3012 has been designated. If NO in step S110, the process

10   advances to step S111 to execute another process such as a process corresponding to a designated button or a wait for an instruction with a button. If the print button has been designated, the process advances to step S112. A "GetDeviceStatus" is issued to the PD

15   printer 1000 to request status information of the PD printer 1000 and acquire status information sent from the PD printer 1000 in response to the request. The process advances to step S113 to determine on the basis of the acquired status information whether the status

20   of the PD printer 1000 is "pause". If YES in step S113, the process advances to step S114 to determine whether an error has occurred and "Warning" is set (e.g., a cable is disconnected), or no error has occurred. If YES in step S114, the restart of a print process is

25   determined to be possible (because the status from the PD printer 1000 has been received). The process advances to step S115 to instruct the PD printer 1000

to restart the print process (transmit "ContinueJob").

If no pause state is set in step S113 or another

error has occurred in step S114, the restart of print

process is determined to be impossible, and a message

5   to this effect is displayed on the UI of the display

unit 2700. In this case, for example, a message is

displayed on the display unit 2700 to notify the user

that print process cannot restart, and/or selection of

the print button is disabled. Wasteful press of the

10   print button by the user can be avoided by acquiring

the statue of the PD printer 1000 before press of the

print button is determined in step S110, and notifying

the user whether ON/OFF of the print button is

effective.

15   Fig. 12 is a flow chart for explaining a print

abortion process executed upon designating a print

abortion button which designates abortion of a print

process in the DSC 3012 according to the fourth

embodiment.

20   In step S121, it is determined whether an

abortion button among the operation buttons 3103 of the

DSC 3012 has been designated. If NO in step S121, the

process advances to step S122 to execute another

process such as a process corresponding to a designated

25   button or a wait for an instruction with a button. If

the abortion button has been designated (pressed), the

process advances to step S123. A "GetDeviceStatus" is

issued to the PD printer 1000 to request current status
information of the PD printer 1000 and acquire status
information sent from the PD printer 1000 in response
to the request. The process advances to step S124 to

5   determine on the basis of the acquired status
information whether the status of the PD printer 1000
is "pause". If YES in step S124, the process advances
to step S126; if NO, to step S125 to determine whether
print progresses. If YES in step S125, abortion of the

10   print process is determined to be possible, and the
process advances to step S126 to instruct the PD
printer 1000 to abort the print process (transmit
"AbortJob").

If NO in step S125, abortion of the print process

15   is determined to be impossible, and a message to this
effect is displayed on the UI of the display unit 2700.
In this case, for example, a message is displayed on
the display unit 2700 to notify the user that print
cannot be aborted, and/or selection of the abortion

20   button is disabled. Wasteful press of the abortion
button by the user can be avoided by acquiring the
statue of the PD printer 1000 before pressing of the
abortion button is determined in step S121, and
notifying the user whether press of the abortion button

25   is effective.

[Fifth Embodiment]

Fig. 13 is a flow chart for explaining a process

in the print system according to the fifth embodiment
of the present invention. A program which executes
this process is stored in the ROM 3101. Also in the
fifth embodiment, the arrangements of the DSC 3012 and

5   PD printer 1000 are the same as those in the above
embodiments, and a description thereof will be omitted.

In the fifth embodiment, when the DSC 3012 issues
any command to the PD printer 1000, the DSC 3012 is
notified of a response from the PD printer 1000 to the

10 command. If the response includes an unestimated
content, the DSC 3012 issues "GetDeviceStatus" to the
PD printer 1000 to acquire the current state of the PD
printer 1000. When the acquired status is one
estimated from the command issued immediately before

15 acquisition and the response content, a normal process
is executed. On the other hand, the status is an
unestimated one, a process corresponding to the status
is executed.

In step S50, a "StartJob" instruction as a print

20 start request is issued to the PD printer 1000. The
process advances to step S51, and if a response to the
print start request is received from the PD printer
1000, the content is determined. If the content
includes "NotExecuted" representing that the "StartJob"

25 instruction could not be executed, the process advances
to step S52 to issue a "GetDeviceStatus" instruction to
the PD printer 1000. In step S53, the DSC 3012 waits

for a response to the instruction from the PD printer

1000, and acquires the current status of the PD printer

1000. In step S54, the reason why the print start

instruction has not been executed is analyzed. If the

5   reason is turned out, the process advances to step S55

to change the UI display and wait for an instruction

input from the user who has used an operation button

3103. If the print start request is input in step S56,

the process advances to step S50 to execute the

10 above-described process. Note, if a command other than

a print request is designated in step S50, a

corresponding process is implemented, but Fig. 13 does

not illustrate this process.

If the response content is not "NotExecuted" in

15 step S51, the process advances to step S57 to determine

whether the content is "NotSupported". If the content

is "NotSupported", the process advances to step S58.

Since the previously issued "StartJob" instruction is

not supported by the PD printer 1000, for example,

20 (impossible designation) is displayed on the UI of the

display unit 2700 so as to represent that the command

is not supported by the PD printer 1000. The meaning

of not supporting the "StartJob" instruction includes a

case in which the PD printer 1000 does not support the

25 "StartJob" instruction itself, and also a case in which

the PD printer 1000 supports the "StartJob" instruction

itself but does not support the currently issued

"StartJob" instruction because an unsupported paper

size or paper type (no-supported items) is designated.

In this case, unsupported print conditions can be

excluded by reconstructing the UI so as to disable

5   selection of an improper paper size or paper type,

similar to the above-described example. This can

decrease the possibility of receiving "NotSupported"

again from the PD printer 1000 when a "StartJob"

instruction is issued again. At this time, a process

10   of, e.g., confirming a paper size or paper type

supported by the PD printer 1000 may be done. After

the UI has been changed in this manner, the process

advances to step S55 to wait for the next instruction

input, and shifts to a corresponding process.

15   If the response content is not "NotSupported" in

step S57, the process advances to step S59. This

assumes that the response is substantially "OK". In

step S59, it is determined whether a predetermined

status notification "NotifyDeviceStatus" is sent from

20   the PD printer 1000 within a predetermined time period.

Assume that the PD printer 1000 accepts only one print

job. If a "StartJob" instruction as a print start

request is issued, "newJobOK" of "NotifyDeviceStatus"

representing that the PD printer 1000 cannot accept the

25   next print job must represent "False". For this reason,

if a predetermined status response corresponding to the

print start request is received in step S59, the

process advances to step S63 to continue the normal

operation, and then completes the operation.

If no predetermined status information is

received within the predetermined time period in step

5   S59, the process advances to step S60 to issue

"GetDeviceStatus" to the PD printer 1000 and acquire

the status of the PD printer 1000. If a response from

the PD printer 1000 is received in step S61, the

process advances to step S62 to determine whether the

10   acquired status is an estimated status corresponding to

the command issued immediately before acquisition and

the response. If YES in step S62, the process advances

to step S63 to perform a normal process. If not

estimated status has been acquired, the process

15   advances to step S64 to execute a process corresponding

to the status.

An example of "an estimated status corresponding

to the response" in the fifth embodiment is a status

which means "printing" as a result of issuing

20   "GetDeviceStatus" when no "NotifyDeviceStatus" is sent

for a predetermined time period though a print start

request is issued in step S50 to receive "OK". In this

case, a normal process can be continued on the

assumption that issuing of "NotifyDeviceStatus" delays

25   due to any reason (e.g., a long time is taken to

transfer an image file). As a different status in the

fifth embodiment, a status which does not mean

"printing" may be sent back in response to issuing of
"GetDeviceStatus". In this case, various cases are
conceivable: a print start request is not normally
processed due to any reason, or print is canceled due
5   to the circumstance of the PD printer 1000 within a
very short time elapsed after the print start request
was issued. These reasons should be combined with
another status information (e.g., error information) to
determine a subsequent process. Also, concurrent use
10   of the arrangement according to the third embodiment
can realize a stabler direct print process.

In the fifth embodiment, the request issuing
timing is changed depending on the process on the image
data supply side. More specifically, the image supply
15   device (camera) issues a predetermined command to the
recording apparatus (printer). After the image supply
device issues the predetermined command, it determines
whether a signal received from the recording apparatus
is a predetermined command response. If the image
20   supply device determines that the signal is not the
predetermined command response, the image supply device
changes the issuing timing when issuing the next
command.

However, the present invention can also be
25   applied to an apparatus or recording apparatus which
receives image data. More specifically, the apparatus
or recording apparatus which receives image data issues

a predetermined command to the image supply device.
After the apparatus or recording apparatus issues the
predetermined command, it determines whether a signal
received from the image supply device is a

5   predetermined command response. If the apparatus or
recording apparatus determines that the signal is not
the predetermined command response, the apparatus or
recording apparatus which receives image data changes
the timing of issuing the next command.

10 [Sixth Embodiment]

        The above embodiments have mainly described
processes in the DSC 3012. The sixth embodiment will
explain a process when the PD printer 1000 acquires
image data from the DSC 3012. The hardware arrangement

15 in the sixth embodiment is the same as that in the
first embodiment, and a description thereof will be
omitted.

        Fig. 14 is a flow chart for explaining an image
data acquisition process in the PD printer 1000

20 according to the sixth embodiment of the present
invention. A program which executes this process is
stored in the program memory 3003a, and executed under
the control of the DSP 3002.

        This process starts when a print request

25 ("StartJob") is sent from the DSC 3012 to designate the
start of a print process. In step S31, "GetFileInfo"
is sent to the DSC 3012 to request information on an

image file desired by the DSC 3012. In step S32, when
information (file size, attribute, or the like) on the
image file is sent from the DSC 3012, an item which is
contained in the information and represents the file
5 capacity is acquired. The process advances to step S33
to determine whether the entire image file can be
received and processed at once. This is determined on
the basis of, e.g., the memory capacity of a free area
in the memory 3003 of the PD printer 1000. If
10 reception of all image data at once is determined to be
impossible, the process advances to step S34 to read
out the image file. A start address and read amount
are designated to request partial image data of the
image file. This is performed using "GetPartialFile".
15 The DSC 3012 reads out the designated partial image
data from the image file in accordance with the start
address and read amount, and transmits the partial
image data to the PD printer 1000. The PD printer 1000
which has received the partial image data in step S35
20 processes and prints the partial image data in step S36.
The process advances to step S37 to determine whether
all image data of the image file have been printed. If
NO in step S37, the process returns to step S34 to
request the next partial image data. This process is
25 repetitively executed until the entire image file
designated in step S32 has been received and printed.

If it is determined in step S33 that image data

of the image file can be received and processed at once,
the process advances to step S38 to request all the
data of the image file of the DSC 3012. In step S39,
all the image data of the image file sent from the DSC
5   3012 on the basis of the request are received and
printed.

Fig. 15 is a flow chart for explaining another
example of the image data acquisition process in the PD
printer 1000 according to the sixth embodiment of the
10 present invention. A program which executes this
process is stored in the program memory 3003a, and
executed under the control of the DSP 3002.

This process starts when a print request
("StartJob") is sent from the DSC 3012 to designate the
15 start of a print process. In step S41, "GetFileInfo"
is sent to the DSC 3012 to request information on an
image file designated by the DSC 3012. In step S42, if
information on the image file is sent from the DSC 3012,
the process advances to step S43 to determine whether
20 the image file contains thumbnail images (index images).
If the image file contains thumbnail images, the
process advances to step S44 to determine whether index
print is designated using the control unit 1010. If
index print is designated, the process advances to step
25 S45 to request the thumbnail image data of the DSC 3012
(issue "GetThumb") and acquire the data. The process
advances to step S46 to execute index print on the

basis of the acquired thumbnail image data.

If the image file does not contain any thumbnail image in step S43 or no index print is designated in step S44, the process advances to step S33 (Fig. 14) to

5   execute the above-described image print process.

In this fashion, according to the sixth embodiment, the image data amount acquired at once from the DSC 3012 can be changed and input from the DSC 3012 in accordance with the memory capacity and process

10   performance of the PD printer 1000.

It can be detected in advance that a thumbnail image has already been stored in the image file of the DSC 3012. When index print is designated in the PD printer 1000, a thumbnail image creation process in the

15   PD printer 1000 can be omitted. Thus, a thumbnail image (index image) can be quickly printed.

The present invention may be applied to a system including a plurality of devices (e.g., a host computer, interface device, reader, and printer) or an apparatus

20   (e.g., a copying machine or facsimile apparatus) formed from a single device.

The object of the present invention is also achieved when a storage medium (or recording medium) which stores software program codes for realizing the

25   functions of the above-described embodiments (processes performed on the camera side and various print processes performed on the printer side) is supplied to a system

or apparatus, and the computer (or the CPU or MPU) of

the system or apparatus reads out and executes the

program codes stored in the storage medium. In this

case, the program codes read out from the storage medium

5   realize the functions of the above-described

embodiments, and the storage medium which stores the

program codes constitutes the present invention. The

functions of the above-described embodiments are

realized when the computer executes the readout program

10   codes. Also, the present invention includes a case in

which the functions of the above-described embodiments

are realized when an OS (Operating System) or the like

running on the computer performs part or all of actual

processing on the basis of the instructions of the

15   program codes.

Furthermore, the present invention includes a

case in which, after the program codes read out from

the storage medium are written in the memory of a

function expansion card inserted into the computer or

20   the memory of a function expansion unit connected to

the computer, the CPU of the function expansion card or

function expansion unit performs part or all of actual

processing on the basis of the instructions of the

program codes and thereby realizes the functions of the

25   above-described embodiments.

As has been described above, according to the

embodiments, when a print process in a printer is

interrupted by disconnecting a cable which connects a
DSC and the PD printer, and after then print process
can be restarted by connecting the cable again, the
print process can be reliably restarted to print.

5   Image data resent from the DSC to the printer is
changed at the restart of print in accordance with
either a print process based on a DPOF file or a print
process of image data sequentially transmitted from the
DSC to the printer. In either case, print can be
10   reliably restarted.

When the DSC according to the embodiments issues
a command such as StartJob or AbortJob to the printer,
the DSC estimates that a predetermined state has been
set even without any response from the printer, and can
15   decide the next operation. The DSC further issues a
command for confirming the status to the printer, and
can identify the current state (status) of the printer.

When the PD printer sends back a specific status
as a response to the DSC, the DSC shifts to a
20   corresponding process. For example, for "NotExecuted"
or "NotSupported", the DSC issues a command which
inquires the state of the printer for the former
command, and decides the next command to be issued on
the basis of the response. For the latter command, a
25   previously issued command is not supported by the
printer, and thus the DSC executes a process of, e.g.,
changing a UI displayed on the display unit so as not

to subsequently issue the same command. This can

prevent resending of a wasteful command to the printer.

Also when the PD printer and DSC almost

simultaneously issue commands, both or at least one of

5   the devices inhibits issuing of a command for a

predetermined time period. This can decrease the

possibility of almost simultaneously issuing commands

from the two devices again.

According to the embodiments, the image data

10   amount acquired at once from the DSC can be adjusted in

accordance with the memory capacity or process

performance of the printer. Image data can be loaded,

processed, and printed.

The present invention is not limited to the above

15   embodiments and various changes and modifications can

be made within the spirit and scope of the present

invention. Therefore, to apprise the public of the

scope of the present invention, the following claims

are made.

20